

R&S®FSV: versatile modulation analysis from MSK to 64QAM

Owing to its innovative operating concept, the new R&S®FSV-K70 vector signal analysis application for the R&S®FSV signal and spectrum analyzers makes it astoundingly easy to analyze digitally modulated single carriers and determine modulation parameters.

Obtaining precise measurement results quickly and easily

Due to the complex areas in which the R&S®FSV-K70 option is used, development of this new vector signal analysis application focused on easy-to-learn operation that allows users to concentrate on their tasks. Operation is based on a completely new concept and therefore differs largely from purely instrument-oriented setting procedures. Basically, the new operating concept rests on three mainstays:

- Description of the signal to be analyzed
- Signal-flow-oriented operating sequence
- Consistent use of the touch screen

Instead of having to think about the instrument parameters that have to be set, the user first describes the signal to be analyzed. This includes, for example, the modulation type, modulation rate, filtering as well as whether the signal is continuous or consists of bursts. All relevant parameters are entered in one place and not across different menus. For the most important mobile radio standards such as WCDMA, GSM, EDGE and TETRA, the signal description is already predefined.

The signal description is integrated into a signal-flow-oriented operating sequence. The graphical representation of the different signal analysis levels which resembles a block diagram shows exactly which parameter acts at which point and

thus provides transparency (FIG 1). A preview window that is adapted to the respective block in the signal flow diagram immediately shows the effects of the selected setting, facilitating the correct choice of the parameters (FIG 2).

All these convenient operating processes consistently use the capabilities of the touch screen on the R&S®FSV. A simple touch on a block in the signal flow diagram is sufficient to access the appropriate setting parameters. The user can zoom in on individual points in a constellation diagram by enlarging a rectangle on the touch screen, for example. The field of interest can thus be scaled to the required size considerably faster than by repeatedly entering axis scaling values. Especially users who only sometimes need these functions will appreciate this convenience. But this feature even benefits experienced users who regularly use vector signal analysis functions.

Versatile tools for detailed signal analysis and identifying error sources

Up to four measurement windows that can be displayed simultaneously are user-configurable with different contents, providing comprehensive analysis at a glance (FIG 4). Constantly recurring, personally preferred or task-related combinations can be easily saved and quickly restored.

With its many custom-tailored applications for all conventional mobile radio standards, the [R&S®FSV signal and spectrum analyzer](#) offers a unique price/performance ratio. For more details, refer to NEWS 196/08 (pp. 18–23).



Condensed data of the R&S®FSV-K70

Modulation formats	MSK/GMSK, DMSK, BPSK, QPSK, 8PSK, DQPSK, D8PSK, $\pi/4$ -DQPSK, $3\pi/8$ -D8PSK, 16QAM to 64QAM
Signal analysis bandwidth	28 MHz, optional 40 MHz (with R&S®FSV-B70)
Symbol rate	up to 11 MHz or 32 MHz with the R&S®FSV-B70 40 MHz analysis bandwidth extension
Analysis length	up to 50,000 symbols
Inherent EVM	1 % for a QPSK signal with 10 MHz symbol rate

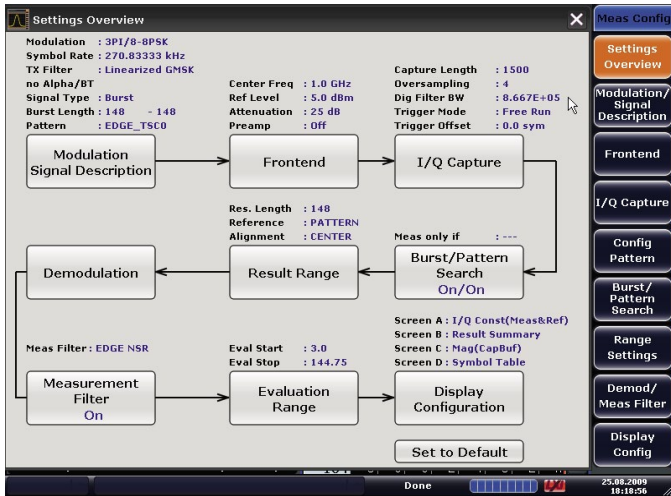


FIG 1 Simply touch the screen: The block diagram of the signal flow provides a quick overview and direct access for operating the functions of the respective blocks.

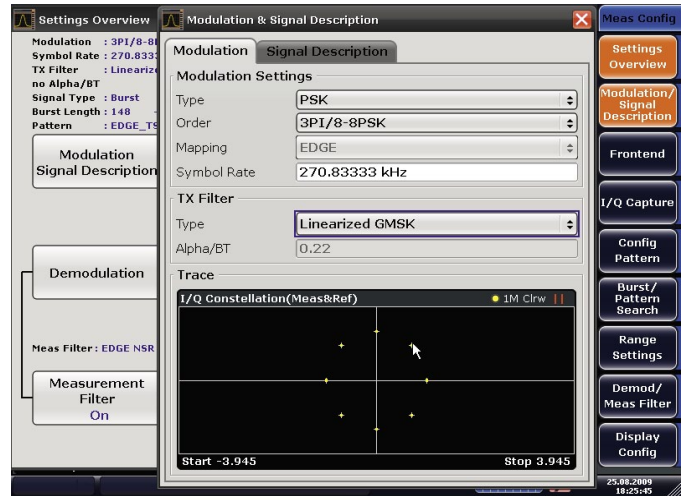


FIG 2 A preview window immediately shows the effect of settings – in this example, of the modulation /signal description block.

FIG 3 shows an example of the versatile display options, including vector and constellation diagram for the measurement and reference signal. Similar display options are available for amplitude, phase and frequency errors and error vector display. Where useful, a time domain display, FFT spectrum and a function for statistical evaluation for further analyses are provided.

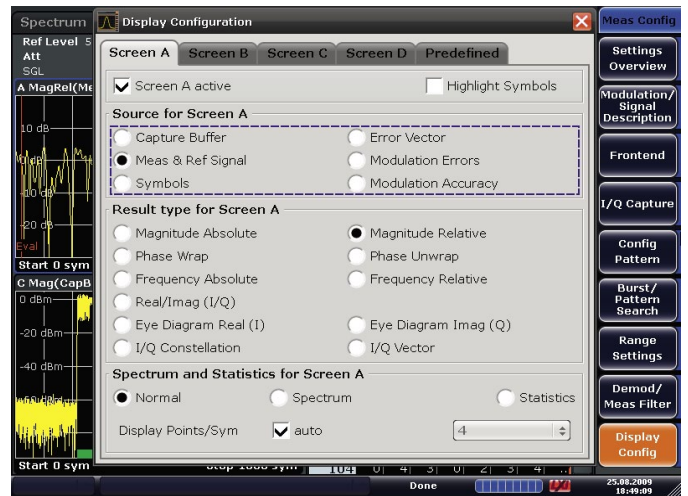


FIG 3 Displays for the measurement and reference signal.

Error causes such as discrete spurious or incorrect filtering can be easily determined in the error spectrum, even if they cannot be detected in the constellation diagram (FIG 4). The raw data spectrum (I/Q capture) provides information about the symbol rate used if it is unknown.

The statistical distribution of the measurement or error signal allows further conclusions to be drawn about the type of modulation error (e.g. noise, sinusoidal interference, signal compression). The R&S®FSV shows the distribution either as probability density function (PDF) or as cumulative probability function (CPF). Furthermore, the statistics function determines the 95:th percentile value – a measurement value that is often required in many standards in addition to the RMS EVM or peak EVM (FIG 5).

Triggering and burst search

The R&S®FSV-K70 option can be triggered both by means of an external trigger (e.g. frame trigger) and, in the case of pulsed signals, by rising or falling RF power (IF power trigger). This accelerates the burst search because data recording is already synchronized to the burst – which, in turn, increases the measurement speed.

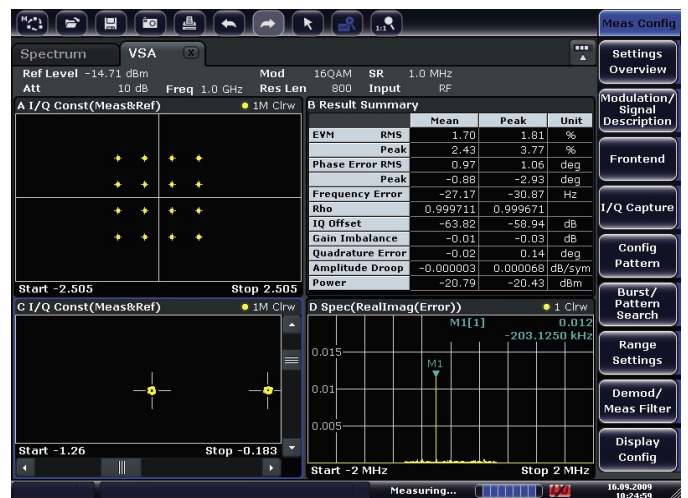


FIG 4 Four measurement windows that can be displayed simultaneously provide a comprehensive overview. In this measurement example, the zoomed constellation diagram and the spectrum of the error vector point to a sinusoidal interferer as cause of the increased EVM value.

A flexible burst search allows the analysis of complex signal combinations, e.g. of short bursts or of signal mixes – a feature that goes beyond the scope of many signal analyzers. By specifying the exact burst length, the user can filter and measure a specific burst from a mix, for example.

Of course, synchronization to data patterns (patterns, mid-ambles or preambles, training sequences), as is necessary for many standard-compliant measurements, is also possible. The most important synchronization sequences for the predefined standards are already included. Separate data patterns can be entered and saved, allowing the user to search also for defective data patterns, for example.

Synchronization is already done by correlating I/Q data and not on bit level after complete demodulation. This provides two advantages:

- Since synchronization takes place very early in the signal flow, data compression can also be performed very early, thus accelerating the measurement
- Correlation is more insensitive to spurious and functions even with poor signal-to-noise ratios. This also helps when measuring bursts at low signal levels, which can be reliably identified (FIG 6) in this way

Seamless integration into the wide range of functions of the R&S®FSV

With signal-flow-oriented operation and consistent use of the touch screen, the new option is seamlessly integrated into the overall operating concept of the R&S®FSV signal and spectrum analyzers. The option increases their versatility and, in combination with numerous further R&S®FSV applications, offers greater benefits for users. For example, a problem such as excessive phase noise in the constellation diagram can be immediately checked and quantified by using the R&S®FSV-K40 phase noise measurement application.

Herbert Schmitt

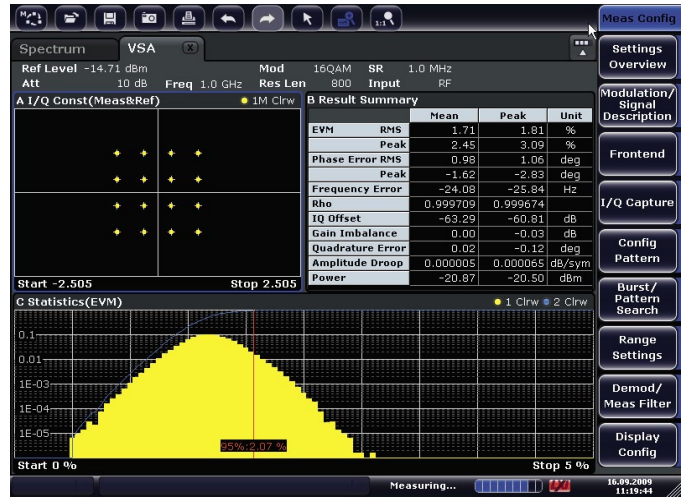


FIG 5 Distribution density function of the error vector with display of the 95:th percentile value.

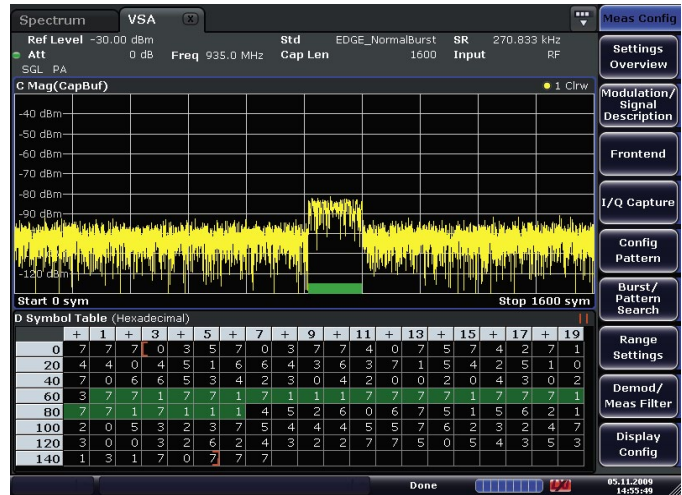


FIG 6 Synchronization to a signal with low signal-to-noise ratio.



FIG 7 Tabular overview of the measured modulation parameters and display of the bit stream.